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STATE OF ALASKA

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ANNUAL REPORT OF PROGRESS, 1961-1962

FEDERAL AID IN FISH RESTORATION PROJECT F-5-R-3

SPORT FISH INVESTIGATIONS OF ALASKA

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INTRODUCTION

This report of progress consists of the job completion reports from the State of Alaska Federal Aid in Fish Restoration Project F-5-R-3, "Sport Fish Investigations of Alaska."

The current project is composed of twenty separate studies and was designed to evaluate the various aspects of the State's recreational fishery resources. The information gathered will provide the necessary background data for better management practices and for the development of future studies. During the current segment, continued emphasis was placed on the overall inventory and cataloging of accessible waters, evaluation of catch data, and investigations on various species of fish.

As a result of several problems of immediate concern, several new studies were instigated during the report year. Data accumulated from these studies has helped solve some problems in projects already in progress.

The population of Alaska is increasing rapidly and this is being reflected in the ever increasing number of "No Trespassing" signs put up by individuals in the vicinity of population centers. Fortunately, much of Alaska's fishery waters are still in the public domain. The division's program of acquiring access to fishing waters continued at a much faster pace since being instigated in 1959. Emphasis is being placed on this job and the successful continuation of this activity will forstall many serious recreational use problems currently facing other states.

The enclosed progress reports are fragmentary in many respects and the interpretations contained therein are subject to re-evaluation as the work progresses.

JOB COMPLETION REPORT

RESEARCH PROJECT SEGMENT

State: ALASKA

Project No.: F-5-R-3 Name: Sport Fish Investigations of Alaska

Job No.: 8-C-4 Title: Sport Fish Evaluation of Ship Creek and Campbell Creek.

Period Covered: July 1, 1961 to March 1, 1962.

Abstract:

Ground surveys revealed a total of 54,560 square yards of gravel available for spawning salmon and trout in Ship Creek and 93,990 square yards of spawning gravel available in Campbell Creek. A concrete dam near the mid-point of Ship Creek limits anadromous fish usage to approximately one-half of their former spawning area.

Eighty adult king salmon were counted in Ship Creek and seventy in Campbell Creek during periods of peak spawning in 1961.

There are presently five dams on Ship Creek. A 40-foot dam located about mid-way upstream, or approximately 11.5 miles above its mouth, is a block to upstream migrants. Waters from the impoundment are taken for municipality purposes. Three steam power plants utilize the downstream by-passed waters for turbine cooling purposes.

Campbell Creek contains one dam near tide-water. Impounded waters form a lake of approximately 80 acres. No industrial water is taken from this stream.

Coal-dust bearing effluent from the steam plants was the only pollution noted in Ship Creek. No pollution was

observed in Campbell Creek.

Recommendations:

It is recommended this study be continued to obtain additional data on all species of sport fish.

Studies of the physical characteristics of the various fish ladders should be continued.

Fish counting weirs or traps should be installed to determine adult salmon and trout escapement in both streams.

No changes in the fishing season are recommended at this time.

Extensive chemical tests should be taken of the steam plant effluents, to determine whether any chemical pollutant is deterimental to salmon or trout.

The following modifications are recommended for the improvement of existing fish ladders:

1. Chugach Electric Association Dam - Ship Creek.

   A deeper channel should be dredged from the fish ladder entrance to the center of the creek. The submerged orifices in the upper three pools should be reduced in size to diminish turbulence.

2. Lower Elmendorf Dam - Ship Creek.

   The outside wall of the fish ladder in the last pool should be raised about 12 inches to prevent fish from jumping over the side and dying in the rock fill. The slot in the uppermost baffle should be moved about one foot from the present location toward the center of the dam in order to facilitate movement from the center of the pool.

3. Campbell Lake Dam - Campbell Creek.

   The arrangement of the boulders forming pools below the culvert could be improved with the addition of more rocks.

Objectives:

To evaluate the effect of the multiple water use on the sport fish populations of Ship and Campbell Creeks and to provide recommendations for improving the runs of anadromous trout and salmon.

Techniques Used:

Surveys were made on the two streams by helicopter, by foating the streams with a rubber raft and by foot. Information collected included total spawning area, populations of adult salmon, number of redds, natural and artificial barriers present, water diversions and location and type of pollutants entering the two streams.

Temperature stations were established on Ship Creek and Campbell Creek. The effects of discharge water from the three steam plants on the temperature of Ship Creek were observed and recorded.

Since time and trained personnel were limited, emphasis was placed on close observations on the effectiveness of the fish ladders and the numbers and spawning activity of the king salmon.

Findings:

A. SHIP CREEK

Historically, Ship Creek has a record of producing a large run of king salmon (Oncorhynchus tshawytscha) as well as pink salmon (Oncorhynchus gorbuscha). Prior to 1942, the entire stream was used by anadromous fish for spawning purposes. In 1942, the first dam was constructed on Ship Creek and four more have been built since. At the present time, there is a remnant run of king salmon with a decrease in numbers of pink salmon. Chum salmon (Oncorhynchus keta) are present in small numbers and, along with the pink salmon, spawn in the lower reaches of the stream. Dolly Varden (Salvelinus malma) are present but are not numerous in the system. Since this stream is closed to salmon fishing, no data were obtained on the catch of these species. No information was obtained on the number of Dolly Varden caught.

Included in this study were the effects of the dams on migrating fish. There are five dams on Ship Creek of various heights, of which only two have fish ladders (Table I).

TABLE I. Location, Height and Distance From Mean Low Tide of Dams on Ship Creek.

Name of Dam	Dam Number	Year Built	Distance From Mouth	Height	Fish Ladder
Chugach Electric Association	1	1952	1.0 miles	6 ft.	Yes
Elmendorf Power Plant	2	?	3.6 miles	5.0 ft.	Yes
Upper Elmendorf	3	1942	4.5 miles	4.5 ft.	No
Ft. Richardson	4	1953	8.2 miles	5.0 ft.	No
City of Anchorage	5	1952	11.5 miles	40.0 ft.	No

Dam number 1 (nearest salt-water) was constructed in 1952 with a fish ladder as an integral part of the structure, (Figure I). It is located approximately one mile from mean low tide. High tides occur within one foot of the dam crest, allowing unobstructed fish passage. At all other times the fish must use the fish ladder which contains six pools with a rise of one foot between each pool. Each of the lower three pools is provided with submerged orifices seven inches wide and nine inches high located at the bottom corners of the baffles. For the purposes of this discussion, a pool baffle is considered to be the wall at the downstream end of each pool. The fourth and sixth pools each have one large submerged orifice centered at the bottom of the baffle twelve inches high and twenty-three inches wide. Sufficient water flows through the ladder so that fish can go over the baffles at the first three pools, but have difficulty passing through the orifices of the upper three pools, apparently due to water turbulence. Each pool is approximately twelve feet long and six feet wide. The amount of water flowing through the fish ladder is regulated by a gate sliding over the orifice in the upper wall of the sixth pool. The fish must go through this submerged orifice to reach the stream above the dam.

The second dam (2) constructed with a fish ladder, is located near the Elmendorf Air Force Base power plant, (Table I).

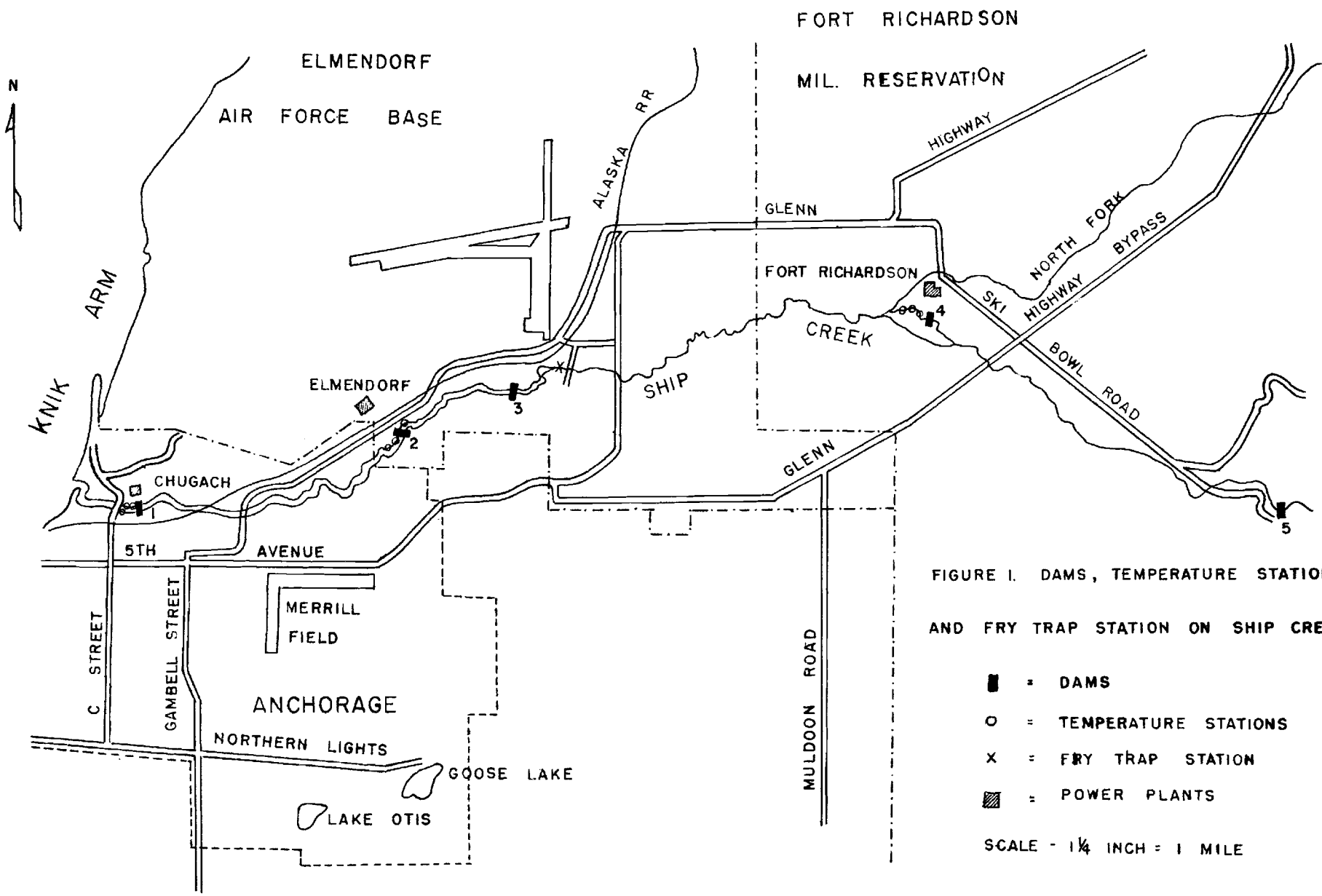

FIGURE I. DAMS, TEMPERATURE STATIONS AND FRY TRAP STATION ON SHIP CREEK.

▮ = DAMS

O = TEMPERATURE STATIONS

X = FRY TRAP STATION

▨ = POWER PLANTS

SCALE - 1¼ INCH = 1 MILE

The ladder entrance is located at approximately the center of the dam and parallels the axis of the dam to its western edge, where provisions are made for fish to enter the stream above. The fish ladder rises five feet and has five pools 8.5 feet wide and 10.5 feet long. Slots alternately placed in the baffles are 15 inches deep and 24 inches wide. The slot for the uppermost pool is next to the left abutment of the dam. It is recommended that this slot be moved at least one foot further away from the wall to improve fish passage. The entire fish ladder is constructed of interlocking steel piling.

Dams 3 and 4 (Table I) do not have fish passage facilities and are 4.5 feet and 5 feet high respectively. Some salmon manage to ascend these two barriers. Plans have been made for construction of ladders during 1962 on these two dams.

Dam number 5, constructed without fish passage facilities is located in a narrow canyon about 11.5 miles from tide-water. The dam is 40 feet high and forms a long narrow pool about one-half mile in length. Stored water is used by two military bases plus the City of Anchorage. Less water was taken from the reservoir in 1960 than in the two previous years (Table II). The reason is that the City of Anchorage has developed a number of deep wells and mixes the well water with the stream water. The well water is about 4°F. warmer than Ship Creek water during the winter months. It is indicated that more water will be flowing in Ship Creek during the winter months than in the past. It is hoped that this will minimize the problem of freezing and desication of salmon and trout eggs, if this has been a contributing factor to their lowered populations. Fears have been expressed that, as more culinary water is needed, eventually Ship Creek may go completely dry during the winter months. More wells are planned and the flow of Ship Creek may be stabilized at approximately the 1960 levels.

Interest has been expressed in building a fish ladder at dam number 5. Construction is not economically justified at this time. No fish were observed immediately below the dam, although sufficient quantities of spawning gravels exist.

Attempts were made to capture salmon and trout fry with a fry trap above Dam 3 from November to the middle of May.

TABLE II. The Average Amount of Water Discharge by Month Flowing in Ship Creek and Amount of Water Used by the City of Anchorage and Fort Richardson for the Years 1958 to 1960, as Measured at Dam 5.

Year	Discharge c.f.s.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1958	Ship Creek	40.8	25.7	19.9	31.9	160.0	463.0	223.0	240.0	120.0	124.0	63.4	38.7
	Water Supply	19.0	18.1	18.3	17.0	20.0	17.8	19.6	18.6	20.5	19.6	16.1	16.2
	Total Flow	59.8	43.8	38.2	48.9	180.0	480.8	242.6	258.6	140.5	143.6	79.5	54.9
1959	Ship Creek	17.5	17.1	11.8	22.3	216.0	538.0	243.0	235.0	205.0	100.0	70.0	46.5
	Water Supply	18.0	17.9	18.0	16.9	14.5	20.3	18.9	17.9	17.9	15.8	11.1	12.9
	Total Flow	35.5	35.0	29.8	39.2	230.5	558.3	261.9	252.9	222.9	115.8	81.1	59.4
1960	Ship Creek	35.9	20.8	12.1	24.3	341.0	432.0	271.0	256.0	240.0	201.0	100.0	90.5
	Water Supply	16.5	16.5	14.4	12.2	12.2	12.4	19.8	18.7	17.6	18.8	17.2	15.7
	Total Flow	52.4	37.3	26.5	36.5	353.4	451.8	290.7	274.7	357.6	219.8	117.2	106.2

c.f.s. - Cubic feet per second.

No fry were captured during trapping operations; however, salmon fry were observed on April 20 just below Dam 2 during a periodic foot survey. Most of the king salmon redds were upstream from the location of the fry trap set.

Temperatures were taken periodically on Ship Creek from November through March at stations selected near the three power plants (Figure 1). The three power plants are located as follows: Chugach Electric Association at Dam 1, Elmendorf Air Force Base at Dam 2 and Fort Richardson at Dam 4. The water for these plants is diverted from the creek for eventual use in cooling steam turbines. Stations 1, 2 and 3 are at the Chugach plant with Station 2 at the plant effluent, Station 1 two hundred feet downstream and Station 3 fifteen feet upstream. Station 5 is located at the effluent of the Elmendorf power plant, with Station 4 located 300 feet downstream from Station 5 and Station 6 thirty feet upstream from Station 5. Station 8 is located at the effluent of Fort Richardson power plant with Station 7 located 150 feet downstream from Station 8 and Station 9 located 30 feet upstream from Station 8. The reason for the varied distances was due to stream access. Each plant has a small storage of water for purposes of re-circulation. In order to keep reservoir water temperature low, a small amount of water is taken continuously from the creek, with the same amount of heated water discharged into Ship Creek. Rough measurements were taken of the effluents from each plant and at no time did they exceed one cubic foot per second.

The stream temperature is increased by the plant discharge, which prevents the formation of ice during winter months. It is not known what effects this may have on the hatching of salmon and trout eggs and the growth of the resultant fry. (Table III)

In addition to the warm water effluent from each plant, there is also an occasional discharge of waste water from flue washing activities. Coal dust and other materials in suspension gives the water a black color, the amount of this effluent is extremely small. This material settles out, giving the stream bed a gray coloration for a distance of approximately 1500 feet downstream; the effects on the spawning beds are not known.

TABLE III. Water Temperatures (^{o}F) of Ship Creek at the Various Stations from November 1961 to March 1962.

DATE	Stations									Air Temp.
	1	2	3	4	5	6	7	8	9	
11/22/61	38	48	33	46	77	35	37	47		
12/1/61	37	52	34	45	76	35	32	48		
12/7/61	33	53	32	45	75	34	33	60		
12/22/61	32	49	32	36	65	35	32	60		-10
2/8/62	36	58	36	50	74	39	32	56		26
2/23/62	36	56	36	46	70	38	34	54		
3/2/62	37	46	36	53	72	40	36	60	34	40
3/9/62	38	50	38	57	71	42	37	67	36	32
3/16/62	39	52	39	52	68	39	36	58	34	30
3/23/62	36	48	36	52	69	42	33	60	32	21
3/29/62	44	54	38	54	72	42	34	66	32	42

Oil pollution in the Stream has occurred several times from Elmendorf Air Force Base. (Oil is stored approximately 500 feet below Dam 3). Proper authorities were notified and corrective measures taken

In an effort to determine the potential production of Ship Creek, the entire stream was surveyed for the amount of available spawning gravels. The gravel was arbitrarily classified as good when the size ranged from 1/4 inch to four inches and marginal when the size ranged from four inches to six inches. Gravel outside these ranges was not considered suitable for spawning purposes. The stream below Dam Number 5 contained an estimated 38,350 square yards of good spawning gravel and 16,210 square yards of marginal spawning gravel for a total of 54,560 square yards of gravel available for spawning purposes (Table IV). Preference for redd building by king salmon was in an area midway from tidewater and the dam where abundant gravel was available.

Assuming that a pair of king salmon utilize about 5 square yards of gravel, there is sufficient spawning area for some 21,820 salmon. It is realized that this figure is high and the optimum number is much lower. Eighty king salmon were counted during the spawning peak during the latter part

TABLE IV. Summary of Potential Spawning Gravel Available in Ship Creek, by Half-mile Sections Going Upstream, and Number of King Salmon and Redds Observed During July, 1961.

Section	Gravel in Sq. Yds. Good	Gravel in Sq. Yds. Marginal	Kings Observed	Jacks Observed	Redds Observed	Remarks
.0-1.0	0	0				Tidewater - silty.
1.0-1.5	1310	270				
1.5-2.0	3850	16				
2.0-2.5	1320	1465				
2.5-3.0	4090	730	5		2	
3.0-3.5	6755	1905	6		8	
3.5-4.0	2770	1180	1 (dead)			
4.0-4.5	3135	1270			3	
4.5-5.0	3150	700	6		2	
5.0-5.5	2073	591	14	5	4	
5.5-6.0	1287	650				
6.0-6.5	2073	1150	1			
6.5-7.0	2106	1020	2		1	
7.0-7.5	1488	670	1			
7.5-8.0	1327	318	9	2	8	
8.0-8.5	1050	1280				
8.5-9.0	105	135				Entire section straight and swift, with dikes on both sides.
9.0-9.5	17	35				
9.5-10.0	107	45				
10.0-10.5	207	170				
10.5-11.0	60	67				
11.0-11.5	75	50				

of July. Pink salmon and chum salmon were observed in the lower three miles of the creek, no counts were obtained on these species.

The stream bed above Dam Number 5 was calculated to contain 37,350 square yards of good spawning gravel and 12,700 square yards of marginal spawning gravel. Total unavailable spawning gravels above the barrier amount to 50,270 square yards. The area above the 40-foot high dam contains approximately one-half of the total spawning gravel of the entire creek. Observations in other streams of the Cook Inlet area indicate that king salmon appear to have a preference for spawning in the uppermost reaches of a stream. The denial of the upper reaches of Ship Creek to king salmon spawning may have caused the present reduced population.

B. CAMPBELL CREEK

Campbell Creek is a smaller drainage than Ship Creek, with minimum winter flows as low as one cubic foot per second in some portions of the stream (Figure 2). The dominant species of fish is the coho salmon (Oncorhynchus Kisutch) closely followed in abundance by king salmon. A few pink salmon and chum salmon spawn in the lower reaches of the stream. Dolly Varden are present in all parts of the stream but are not abundant. Threespine stickleback (Gasterosteus aculeatus) are abundant in the reservoir. It is not known if the populations of salmon and trout have declined in this drainage. Campbell Creek is open to trout fishing during the regular open season. Salmon fishing is allowed from August 22 to September 23. Dolly Varden were the only species caught by anglers during the periodic creel checks. No salmon were recorded caught by anglers contacted along the stream.

An earth fill dam was constructed across Campbell Creek, at tidewater, in 1958, forming a reservoir of about 80 acres. The original fish ladder on this dam was built of wood while the spillway was constructed of concrete. The pools in the fish ladder were four feet square and considered too small for easy passage of either salmon or trout. The spillway and fish ladder were completely removed in 1961. A culvert eight feet in diameter, set at zero grade, was placed in the old location of the spillway. To provide a passageway for fish, the earth fill was extended about 150 feet into the lake in

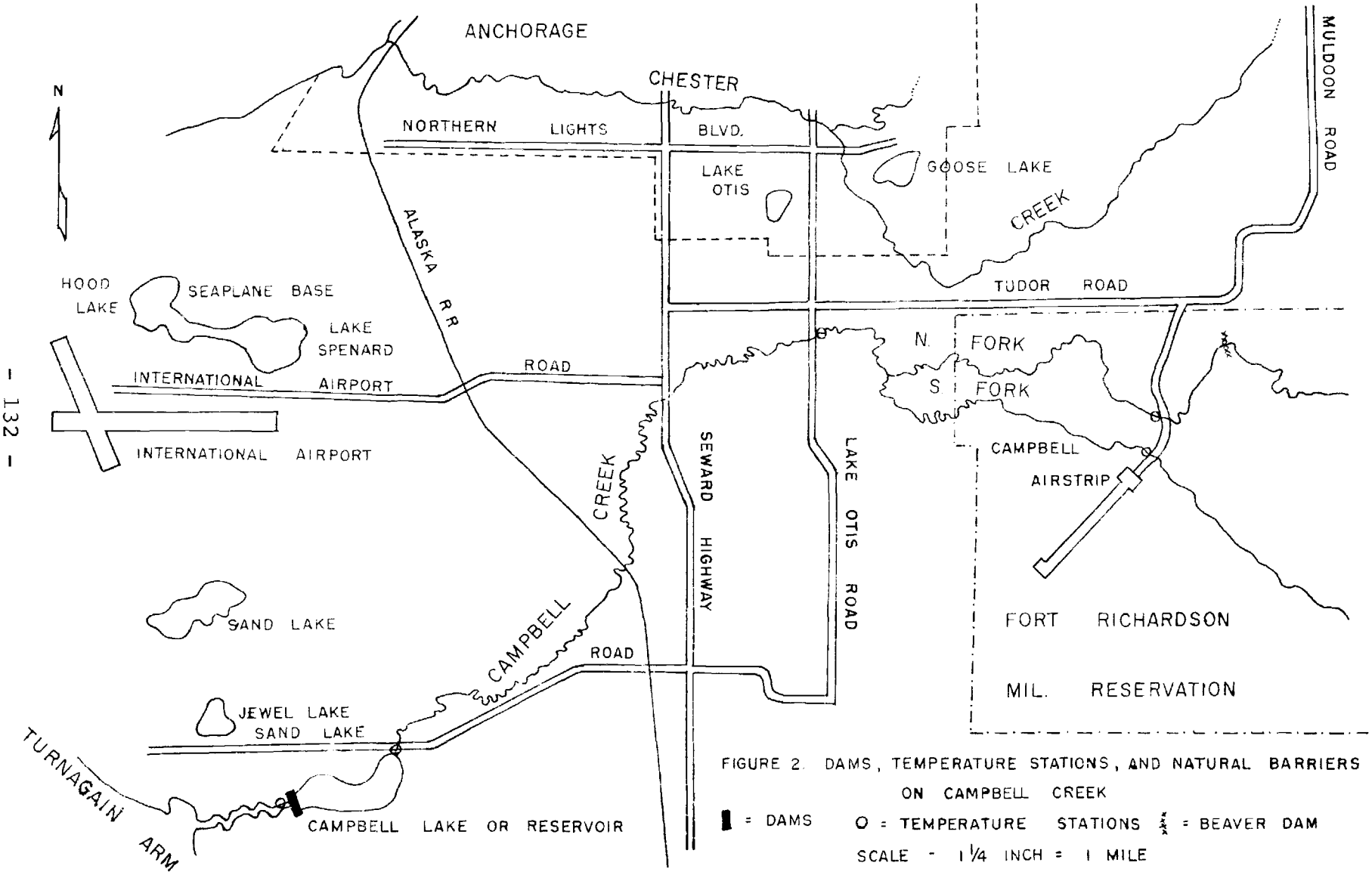

FIGURE 2. DAMS, TEMPERATURE STATIONS, AND NATURAL BARRIERS ON CAMPBELL CREEK

▮ = DAMS O = TEMPERATURE STATIONS ⁂ = BEAVER DAM

SCALE - 1 1/4 INCH = 1 MILE

the shape of an inverted "U" (see figures 3 & 4). A drop of eight feet occurs between the lake and culvert. Boulders and gravel were placed in the stream above the culvert to prevent erosion.

During high tides, migrating fish are capable of passing through the culvert and into the stream above. The total distance between the culvert outfall and normal streambed below (periods of low tide) is six feet; a boulder and gravel three-foot fill reduces the distance to one-step. If the present rock arrangement can be maintained, migratory fish should have no difficulty going upstream. (Figure 5)

In March, 1962, three temperature stations were established on Campbell Creek. The stream temperatures during the month were a constant 32°F.

Stream surveys were conducted by foot, helicopter and by floating the stream with a rubber raft. Information was recorded on amounts of spawning gravels and number of barriers.

The main streambed contains approximately 35,800 square yards of good spawning gravel (Table V) and 14,800 square yards of marginal spawning gravel for a total of 50,600 square yards. The North Fork of Campbell Creek contains approximately 13,960 square yards of good gravel and 6,220 square yards of marginal gravel for a total of 20,180 square yards. The South Fork of Campbell Creek contains approximately 19,000 square yards of good gravel and 4,210 square yards of marginal gravel for a total of 23,210 square yards. Again, assuming that one pair of king salmon requires about five square yards of gravel, there is sufficient spawning area for about 37,590 fish. This figure is admittedly high and the optimum number no doubt is much lower. The total number of king salmon counted on a foot survey during the latter part of July, 1961 was 70 adults. No counts of other species of fish were made due to lack of manpower and time.

A beaver dam located about four miles from the mouth of the North Fork of Campbell Creek was found to be the only barrier impassable to upstream migrants. This barrier reduced the available spawning gravel by approximately 3,360 square yards.

Figure 3. Downstream View of Campbell Creek Reservoir Outlet.

Figure 4. Upstream View of the Outlet of Campbell Creek Reservoir with Edge of Culvert in Lower Right Hand Corner

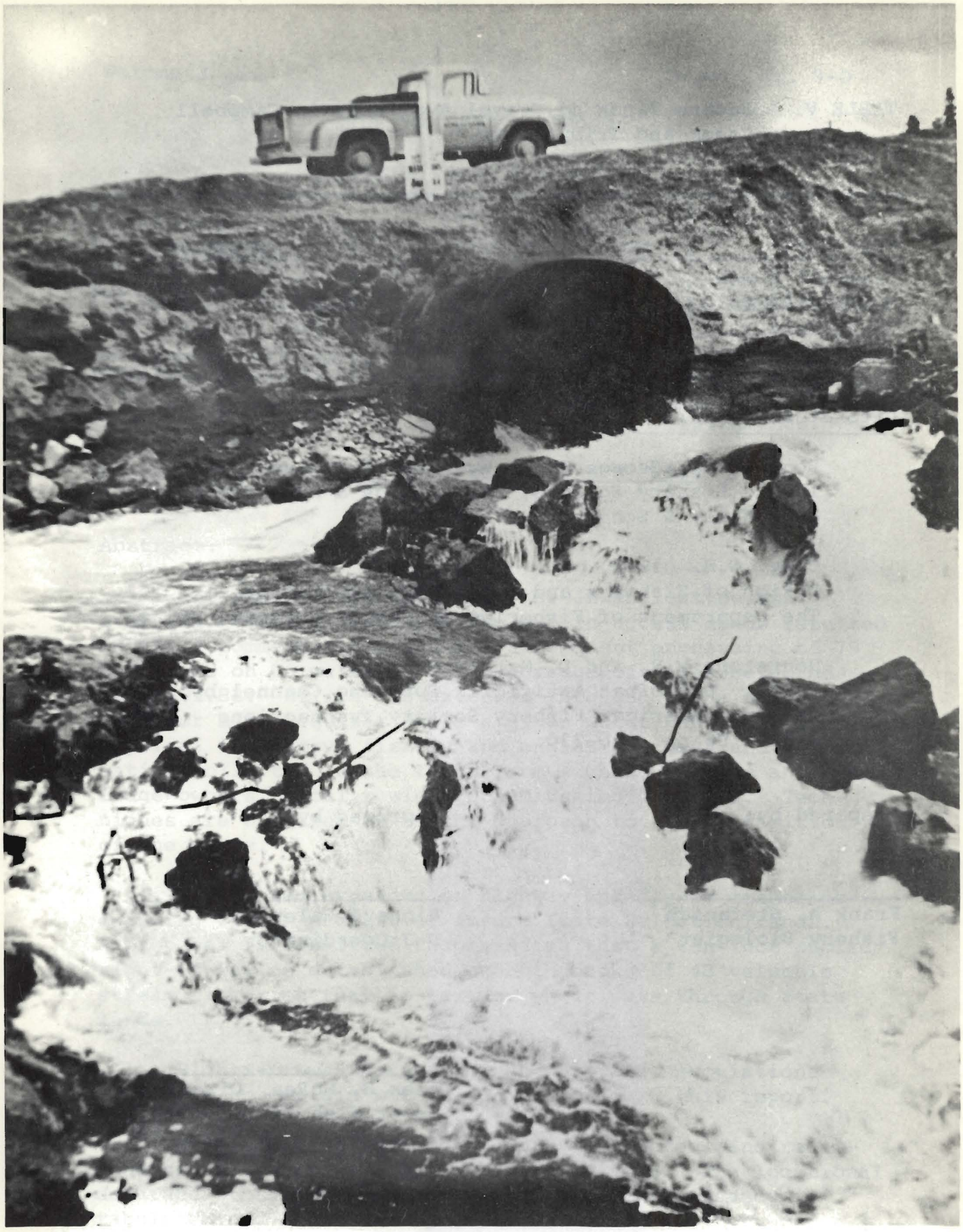

Figure 5. Outlet of Culvert at Campbell Creek Dam, Showing Boulder-formed Pool. Original Stream bed is in Lower Right Corner of Picture.

TABLE V. Square Yards of Gravel Available in Campbell Creek and Tributaries.

Location	Gravel			Potential Spawners
	Good	Marginal	Total	
Campbell Creek	35,803	14,797	50,600	20,240
South Fork	19,000	4,210	23,210	9,284
North Fork	13,960	6,220	20,180	8,072
TOTALS	68,763	25,277	93,990	37,596

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